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THE POLITICAL ECONOMY OF RURAL ELECTRIFICATION IN INDIA

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THE POLITICAL ECONOMY OF RURAL ELECTRIFICATION IN INDIA

by

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December 2018

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As developing countries climb the ladder of economic and social development, providing electricity to their poorest citizens becomes a social imperative, but the distribution of electricity in poverty-stricken regions is frequently more complex than simply installing electrical towers. This thesis focuses on rural electrification in India, focusing on how politics interacts with technical and economic factors in the design and implementation of the government's electrification schemes. It finds that entrenched political interests, developed during Britain's colonial era and cultivated in the years since independence, have historically been more interested in rent-seeking and treating electricity as a political favor than in developing electrical infrastructure. India's unique legacy of colonial, distributive, and bureaucratic politics have resulted in a patronage-oriented political economy that affects the relationship between citizens and would-be electrical providers and also has direct impacts on investment and development in the electricity sector.

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THE POLITICAL ECONOMY OF RURAL ELECTRIFICATION IN INDIA

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requirements for the degree of

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ABSTRACT

As developing countries climb the ladder of economic and social development, providing electricity to their poorest citizens becomes a social imperative, but the distribution of electricity in poverty-stricken regions is frequently more complex than simply installing electrical towers. This thesis focuses on rural electrification in India; how politics interacts with technical and economic factors in the design and implementation of the government's electrification schemes. It finds that entrenched political interests, developed during Britain's colonial era and cultivated in the years since independence, have historically been more interested in rent-seeking and treating electricity as a political favor than in developing electrical infrastructure. India's unique legacy of colonial, distributive, and bureaucratic politics have resulted in a patronage-oriented political economy that affects the relationship between citizens and would-be electrical providers and also has direct impacts on investment and development in the electricity sector.

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LIST OF ACRONYMS AND ABBREVIATIONS

ANC	African National Congress (South Africa)
BJP	Bharatiya Janata Party (India)
BSP	Bahujan Samaj Party (India)
CEA	Central Electricity Authority (India)
CFL	Compact fluorescent lightbulb
DDUGJY	Deendayal Upadhyaya Gram Jyoti Yojana
EA	Electricity Act (India)
EBSST	Electricity Basic Services Support Tariff (South Africa)
GoI	Government of India
GW	Gigawatt
IAP	Indoor air pollution
KJP	Kutir Jyothi Program (India)
kW	Kilowatt
kWh	Kilowatt-hour
IEA	International Energy Agency
IMF	International Monetary Fund
LED	Light emitting diode
LNG	Liquid natural gas
MDG	Millennium Development Goals
MoP	Ministry of Power (India)
MNP	Minimum Needs Program (India)
MW	Megawatt
NEF	National Electrification Fund (South Africa)
NEP	National Electrification Programme (South Africa)
NGO	Non-government organization
NER	National Electricity Regulator (South Africa)
OBC	Other Backwards Classes (India)
PBMR	Pebble bed modular reactor
PV	Photovoltaic
RDP	Reconstruction and Development Programme (South Africa)

RE	Renewable energy
REC	Rural Electrification Corporation, Limited (India)
REST	Rural Electricity Supply Technology (India)
RGGVY	Rajiv Gandhi Grameen Vidyutikaran Yojana (India)
SEB	State Electricity Board (India)
SHS	Solar home system
SP	Samajwadi Party (India)
UP	Uttar Pradesh
W	Watt
WTO	World Trade Organization

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I. THE POLITICAL ECONOMY OF RURAL ELECTRIFICATION IN INDIA: AN OVERVIEW

A. MAJOR RESEARCH QUESTION AND FINDINGS

What explains the patterns of rural electrification in India? This thesis examines the politics of rural electrification in India, including an assessment of the extent to which corruption and colonial roots played a role, in order to provide the context surrounding the technological/engineering, political, and economic factors that determine how and where electrification is implemented. It finds that entrenched political interests, developed during Britain's colonial era and cultivated in the years since independence, have historically been more interested in rent-seeking and treating electricity as a political favor than in developing electrical infrastructure. India's unique legacy of colonial, distributive, and bureaucratic politics have resulted in a patronage-oriented political economy that affects the relationship between citizens and would-be electricity providers and also has direct impacts on investment and development in the electricity sector.

B. SIGNIFICANCE OF THE RESEARCH QUESTION

Accessible and stable electrical power sources are an important measure of growth and development of populations in the hinterlands of developing countries. Accordingly, major international institutions of development, such as the International Monetary Fund (IMF) and World Bank, have prioritized electrification as major policy and program objectives. The World Bank's report, *Energy Services for the World's Poor,* disagrees with the World Energy Agency's (WEA) assessment that approximately two billion people live without electricity may actually be underestimated. World Bank further posits that a true estimation may be impossible due to inconsistent definitions of "access to electricity" and the proliferation of non-grid, distributed power systems that are difficult to assess.[1]

Electricity provides three sets of general benefits, as evidenced by the West's experience with electrification in the 19th and early 20th centuries. First, electrical devices

[1] World Bank, *Energy Services for the World's Poor*, Report No. 20824 (Washington, DC: World Bank, 2000), http://documents.worldbank.org/curated/en/443371468764055824/pdf/multi-page.pdf

can be more efficient and therefore cheaper to operate than their fossil fuel contemporaries. Diesel-fueled engines, whether for locomotion or irrigation pumps, may be replaced by electrical motors in some cases; the reduction in weight equates to an energy savings to accomplish the same amount of work. Second, electrical devices are an entirely new technology, permitting new means of communication, education, and health care thanks to radio, lighting, and modern refrigeration. Third, moreover, the energy savings can be applied to increase productivity; for the same given amount of energy, electricity makes possible a greater output over time. Irrigation, for example, can lead to higher crop yields. Education about the benefits of electricity is key, as electrical demand is a lagging indicator and electricity without demand is useless. Demand for electrical lighting is a signal for desiring better education.

C. LITERATURE REVIEW

Governments keen on establishing rural electrification are struck by two sides of the same coin: making electricity affordable while at the same time convincing government officials that it is in their best interest to pay for it. Affordability is usually at least partially solved through subsidies and other economic policies. Households are also better able to afford electricity as their incomes increase as an indirect result of electrification and economic development. Willingness to pay is partly driven by education and public awareness campaigns espousing the virtues of electricity, such as increased health from avoiding toxic smoke and gasses.[2] The arguments must also compare the cost of electricity to the current power source. For example, despite the availability of kerosene for lighting and cooking, it is viewed as a luxury item compared to continuing to burn firewood or other biomass. Kerosene is used, although sparingly, because the perceived cost of purchasing it is more than the opportunity costs lost while gathering firewood or dung.

Electricity as a public good comes with a set of politics and economics that generate subsidies for the poor and remote hamlets, but frequently fall under the sway of powerful elites. The interests of the politicians become an integral part of the schemes in which any

[2] Emily Rains and Ronald J. Abraham, "Rethinking Barriers to Electrification: Does Government Collection Failure Stunt Public Service Provision?" *Energy Policy* 114 (March 2018): 288.

change to the system becomes nearly impossible. Policies become focused on ever more subsides which translate into increased power and wealth for the elites.[3] Williams, et al., point out that acquiring capital for electrification projects is difficult due to the perceived risk; not only are projects subject to theft and vandalism, but political chicanery at all levels of government.[4] In short, the prime mover shifts from the electrical needs of the customers to the political interests that drive subsidy policies. The subsidies become entrenched and resistant to change, not only artificially affecting the financials of the energy sector, but creating the patron-client dynamic that creates subsidies that fail to achieve their intended purpose. For example, per the IEA, global spending on subsidizing cooking fuel in 2010 was USD409 billion, while only 8% of that reached the bottom fifth of the population.[5]

Some studies, such as those conducted by the International Growth Centre, posit a purely technical argument, claiming that advances in non-grid systems are insufficient for effecting meaningful change in India's rural electrification rates.[6] However, this argument is incomplete given its lack of consideration for the impact of bureaucratic institutions and their interaction with consumers and political elites. Scholars at the World Bank take a more holistic view, acknowledging that regulation is a crucial component of the sector provided that private enterprise is an engaged stakeholder and the regulators are truly independent, free from political influence.[7]

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[3] Sunila Kale, "Current Reforms: The politics of policy change in India's electricity sector," *Pacific Affairs,* 77, no. 3 (2004): 468. https://www.jstor.org/stable/40022911.

[4] Nathaniel Williams and Paulina Jaramillo, "Enabling Private Sector Investment in Microgrid-based Rural Electrification in Developing Countries: A Review," *Renewable and Sustainable Energy Reviews* 52 (December 2015): 1268. Doi: 10.1016/j.rser.2015.07.153.

[5] International Energy Agency, *Joint Report by IEA, OPEC, OECD, and World Bank on Fossil-fuel and other energy subsidies: An Update of the G20 Pittsburgh and Toronto Commitments*, (IEA: Washington, D.C.), January 2011, https://www.oecd.org/env/49090716.pdf.

[6] Michael Aklin, Patrick Bayer, S.P. Harish, and Johannes Urpelainen, *Rural electrification with off-grid community microgrids.* International Growth Centre. December 2015, 16. https://www.theigc.org/wp-content/uploads/2017/05/Aklin-et-al-2015-Final-report.pdf

[7] Achilles G. Adamantiades, John E. Besant-Jones, and Mangesh Hoskote, "Power Sector Reform in Developing Countries and the role of the World Bank," (paper presented at the 16th Congress of the World Energy Council, New York, September 1996), 14. http://documents.worldbank.org/curated/en/477941468740362190/Power-sector-reform-in-developing-countries-and-the-role-of-the-World-Bank-paper-presented-at-the-16th-Congress-of-the-World-Energy-Council-Tokyo-October-8-13-1995

Roughly 75% of India's population is still rural and remote. Traditional fuels continue to be used, as families are either unwilling or unable to pay for electricity, which is viewed as a luxury item. Most households rely on biomass (firewood, crop waste) while others use kerosene. Kerosene in particular is an important backup fuel source for lighting and cooking. Even urban consumers, who mostly consume electricity, supplement their power with wood, gas, and kerosene. The International Energy Agency (IEA) assesses that nearly every village in India has access to electricity yet actual household connection rates languish at around 60%.[8]

Low connection rates are common for the poorest citizens, as inability to pay, shoddy construction, and unreliable services frequently lead to the decision to forego adoption of modern electricity and continue to use time-tested sources. As might be expected, demand for electricity is inversely related to its price; the market prices of biomass and petroleum are inextricably linked to that of electricity when considering consumption. Reliability appears to be a significant factor as well. The World Bank has noted that increasing the availability by one hour increases household connection rate by 2.7% and consumption by 14.4%.[9] This reinforces the notion that access alone is insufficient; service reliability must be factored in order to see meaningful gains.

Regardless of the social imperatives placed on rural electrification, establishing the infrastructure to generate, transmit, and consume electricity are not immune from economic concerns. The cost of electricity is compared with current substitutes, e.g., kerosene and biomass. Electrification schemes and subsidies are discussed not only in terms of benefits to the poor but also benefits to administrators and politicians. This thesis will include a brief discussion on the future of rural electrification programs and how best to proceed, particularly given recent advancements in renewable energy technologies.

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[8] International Energy Agency, *World Energy Outlook 2009,* (Paris: IEA, 2010), 538. http://www.iea.org/publications/freepublications/publication/weo2009.pdf.

[9] World Bank, *The Welfare Impact of Rural Electrification: A Reassessment of the Costs and Benefits: An IEG Impact Evaluation,* (World Bank: Washington, D.C.), http://siteresources.worldbank.org/EXTRURELECT/Resources/full_doc.pdf.

Electrification has non-trivial effects on populations ranging from improved health to economic growth. Numerous barriers exist to deployment, including socioeconomic concerns (e.g., caste and cost) and engineering factors (e.g., single-home solar photovoltaic versus local diesel grid). An examination of patterns of rural electrification use in India can provide insights with respect to the underlying causal drivers of policy choices made, especially the extent to which political and historical factors undermine the most technically and economically efficient policies. Electrification is important both in and of itself and as a contributing factor to improved economic development.

D. ARGUMENT AND THESIS ORGANIZATION

The rate of rural electrification throughout India has been lackluster in comparison to the experience of other developing nations and this thesis provides an analysis of the historical and current socio-political contexts in which various reforms have been enacted. It is argued here that while numerous political campaigns have been launched under the guise of public benefits, the outcomes are almost universally constrained by the same institutions. Officials are tasked with the responsibility of not only providing services but also developing the regulations that bind them. This circular relationship of ownership, distributor, and regulator lead to a culture of corruption and rent seeking that ultimately fails to deliver on the initial promise. Under this construct, existing relationships cannot be relied upon in future reform schemes. It would be foolhardy, however, to hold accountable any one institution in such complex systems. This thesis shows that not only entrenched interests but also institutional and technological path dependencies, socio-economic status, and career opportunism define India's rural electrification outcomes. Scholars such as Drs. Sunila Kale and Brian Min argue that while political ideology and external pressures contribute to India's electrification outcomes, it is in the relationship between citizens and the state institutions that form the largest barrier and it is this perspective that is the most convincing.[10]

[10] Kale, "Current Reforms: The politics of policy change in India's electricity sector."

This thesis examines three major contributors that explain the lackluster outcomes from India's attempts at rural electrification: the engineering and other technical challenges inherent in the development and deployment of non-grid electrical systems, entrenched rent-seeking and legacy patronage politics from India's colonial period, and economic factors that drive investor support, or lack thereof. This thesis argues that the confluence of geography, technology, and bureaucratic barriers contribute to the sub-optimal outcomes of India's rural electrification schemes.

The research for this thesis is necessarily descriptive; official publications, websites, and institutional releases are examined, as are the results of external studies by international bodies such as the World Bank and Asian Development Board. Case studies conducted by government and independent organizations are examined for causal relationships and correlation. The methods used here establish the foundation for examining how institutional actors and interests initiated each reform scheme as well as suggest areas for further research with respect to rural electrification outcomes. Results and published works of specialists such as Dr. Kale and Dr. Min are also incorporated.

Chapter II provides an overview of India's current grid system and examines the differences between grid and non-grid electrical systems. A case study analysis of South Africa's rural electrification experience is presented in order to highlight the technical issues involved as well as some socio-political parallels and, ultimately, compare the outcomes of the two countries' programs. Chapter III examines India's legacy of distributive politics and its relationship to India's colonial history. The historical analysis then informs an overview of the evolution of India's rural electrification programs starting in the late 20th century. This combination of technology and political economy develops the conclusion in the final chapter that technology, institutions, and regulatory space are inseparable determinants of effective rural electrification.

II. THE TECHNICAL DIMENSIONS OF RURAL ELECTRIFICATION IN DEVELOPING COUNTRIES

India suffered from a relatively anemic economic growth rate since its independence in 1947, largely due to the preference for socialism on the part of its nationalist leaders, including Mahatma Gandhi and Jawaharlal Nehru, the country's first prime minister. The global economic downturn in 1991 provided the impetus for market-oriented reforms, leading to an average growth rate of 5.4% per year.[11] The reforms marked a departure from central planning, especially through deregulation and tax reform. One effect of the reforms and subsequent uptick in economic growth was growth of the middle- and upper-class populations that, among other things, drove an increase in demand for electrical power as citizens acquired electrical appliances.

While economics drove the demand for electricity, expanding availability to both urban and rural customers has proven most challenging from an engineering perspective. The competing interests and providers, such as those found in the state electricity boards (SEB), have resulted in a mismatched system of grid and non-grid supplies based on the favored contractor. This mismatch leads to gross inefficiencies, line loss, theft, and vandalism that contribute to an ill-served customer base.

This chapter examines the engineering challenges in deploying a robust electrical generation, transmission, and distribution system. In order to better understand India's particular challenges, South Africa is used as a comparative case study given their similar colonial histories. Colonialism does not affect modern electrification per se, but the attitudes and culture developed throughout the colonial period has formed the institutional culture and regulatory space that exists today, at least partly explaining how engineering decisions are made at the government level. An examination of the technical aspects illustrates why certain solutions, such as solar-home systems (SHS), can be more beneficial to both the customer and the provider than, for example, a grid connection.

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[11] World Bank, *India Development Update,* (New Delhi, India: World Bank, March 2018), 13. https://openknowledge.worldbank.org/handle/10986/29515.

A. GRID SCHEME

Most Westerners are familiar with the standard grid electrical system in which power is distributed from a generating station to homes through a series of substations. Topography restricts extension of the grid into the hinterlands; beyond a certain point the cost becomes untenable. Engineers have developed numerous schemes to overcome the obstacles of grid service, ranging from so-called mini-grid systems that can electrify a small village to self-contained solar home systems, or SHS, or photovoltaic (PV) system for individual homes. Sizes of power plants can vary wildly, from under 5 kW to over 300 MW. Since India is blessed with abundant sunshine, some estimate that 0.1% of land could deliver up to 146 GW of PV-based electricity.[12]

Grid systems, perhaps unsurprisingly, spread from dense urban centers to rural areas. Grid electrification, then, cannot easily be separated into "rural" versus "urban" electrification as investments in the grid are inherently investments in projected rural projects. One of the effects of electrification has been a commensurate rise in prosperity, usually measured in terms of productivity and household incomes. It also follows that higher per capita incomes will consume increasing amounts of electricity as they are better able to afford more efficient appliances.

As urban centers become electrified, eyes turn toward the hinterlands. Politically, rural electrification is a symbol of progress and, despite the physical difficulties and financial non-viability, remains a high governmental priority. The challenges in maintaining a mini-grid, or even a SHS, are legion. Theft is a universal problem; thieves and vandals will harvest infrastructure (e.g., transformers) for the raw materials.[13] Methods of stealing electricity are limited only by the imagination and knowledge of basic electronics of the thieves. Extra taps are frequently added to load centers while some people are capable of manipulating meters. Those who can afford it can even purchase a tank

[12] Sanjeev H. Kulkarni and T. R. Anil, "Rural Electrification through Renewable Energy Sources—An Overview of Challenges and Prospects," *International Journal of Engineering Research,* 3 (2013): 386.

[13] Debajit Palit and K. Sarangi, *Renewable Energy-Based Rural Electrification: The Mini-Grid Experience From India* (New Delhi: Global Network on Energy for Sustainable Development, 2014).

circuit: a means of wirelessly absorbing electricity through the magnetic fields around transmission wires.[14]

The costs of generation in a grid system are affected by economies of scale. The load factor—the ratio of average to peak consumption for the system—directly affect the cost of operation. If, for example, the load factor is high, then the cost for a central power plant is lower as the cost is spread over more consumers. This means that a high load factor for a smaller, non-grid system will suffer from high fuel and operating costs. Urban centers are better able to mitigate these costs, as residential customers typically have heavy demand in the morning and evening with industrial users supplying the demand throughout the day. Distance also plays a role, as establishing power lines to remote areas is a high one-time cost, but line losses—loss of available power due to the electrical resistance of the power lines—also increase over distance.

India, as the fourth largest consumer of electricity in the world after the United States, China, and Russia, still suffers from a demand/generation mismatch.[15] At least 25% of the population lacks access to electricity and those that do suffer from rolling electricity blackouts.[16] The percentage of electrification is further divided when considering urban centers vice rural households; 94% of city homes have electricity compared to 60% of rural households.[17]

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[14] Power lines generate magnetic fields while electricity is flowing through them. A tank circuit placed within the magnetic field works in reverse, absorbing the magnetic field and converting it to electrical current. Modern power companies have sophisticated systems to detect such theft but less-complex—and many non-grid—systems do not.

[15] "India's Economic Growth is Driving its Energy Consumption," U. S. Energy Information Administration, April 1, 2012. http://www.eia.gov/todayinenergy/detail.php?id=10611.

[16] Todd Lindeman, "1.3 Billion are Living in the Dark," *Washington Post,* November 6, 2015, https://www.washingtonpost.com/graphics/world/world-without-power.

[17] Sun-Joo Ahn and Dagmar Graczyk, "Understanding Energy Challenges in India—Policies Players and Issues," (Paris: IEA, 2012): 24. https://www.iea.org/publications/freepublications/publication/India_study_FINAL_WEB.pdf.

India's power grid is one of the most inefficient in the world, with up to 50% transmission losses.[18] It is also one of the most unequal across the country, as shown in Figure 1, with powerful elites and politicians negotiating electricity in exchange for political gain. The existence and development of the grid is, perhaps not unreasonably, conflated with the actual distribution of electricity. As an example, Uttar Pradesh, despite being the most populous, is also the poorest with several institutional barriers to electrification.[19] The demand exceeds the energy supply, which causes rolling blackouts within the province, leading to a political process in which the citizens vote for the candidate who promises to deliver more basic services. Electrification, as a policy goal, has been achieved by virtue of building the infrastructure for power delivery (e.g., transformers and power lines) but the pernicious assumption is that power is supplied on demand. While some areas suffer daily blackouts, elected officials routinely meddle in energy affairs, declaring their client areas immune from the daily cuts.[20]

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[18] Namrata Kohli, "The Loss of Power," *Economic Times,* October 2, 2014. http://economictimes.indiatimes.com/new-sections/energy/the-loss-of-power/lifenologyshow/44083310.cms.

[19] Brian Min, *Power and the Vote,* (New York: Cambridge University Press, 2015), 127.

[20] Min, *Power and the Vote,* 131.

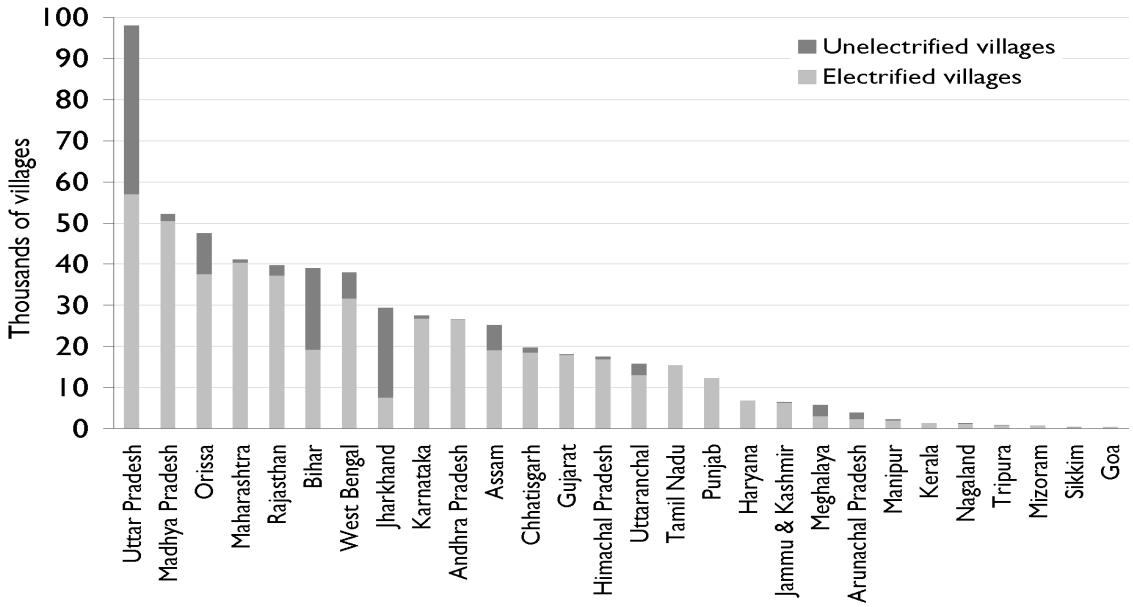

Figure 1. Village Electrification Rates in Indian States, 2005[21]

Electrical power has thus far enjoyed both a strong public-sector presence (e.g., state-run power companies) and excessive subsidies.[22] The subsidies tend to discourage private investment, particularly when combined with the fact that not only do the state agencies micro-manage infrastructure and distribution, but India's federalist system of government requires close coordination between central and state governments. The central government creates policy and frequently provides funding, but it is up to the states to actually implement the schemes. Poor growth is usually a self-fulfilling prophecy; lack of public investment in infrastructure discourages private investment with the associated failure in growth rates.[23]

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[21] Source: Min, *Power and the Vote,* 129.

[22] Subhes C. Bhattacharyya, "Energy Access Problem of the Poor in India: Is Rural Electrification a Remedy?" *Energy Policy* 34 no.18 (2006): 3392, Elsevier.

[23] Atul Kohli, "Politics of Economic Growth in India, 1980–2005, Part II: The 1990s and Beyond," *Economic and Political Weekly,* April 8, 2006, 1365.

B. NON-GRID SCHEME

The costs in establishing a non-grid distribution system are non-trivial but considerably less than extending the grid to remote hamlets. India provides relief to rural customers by subsidizing the costs. There are currently four projects running in parallel, two private ventures and two public utilities. All provide enough electricity to provide a home with basic lighting, cooking heat, and possibly a fan outlet or cell phone charger at a subsidized cost of $0.50 per week to $2.50 per month.[24] In order to combat theft, proprietary connectors and smart meters are used.

Companies have discovered another means of eliminating local theft and corruption: training villagers to perform basic maintenance.[25] Distributing maintenance in addition to electricity has proven quite efficient; each village appoints a technician who reports to a regional master technician. The village also assigns bill collection to a different person; separating maintenance from accounts receivable further reduces potential graft and conflicts of interest. This model of distributing ownership encourages village investment and inhibits vandalism and theft, either of raw materials or power.

One challenge of managing power systems is essential maintenance. No system is ever truly self-sufficient and all require at least some form of periodic upkeep. Grid systems are staffed with full-time engineers and technicians; the wide dispersal of non-grid systems make that unfeasible, especially considering the cost and difficulty of transporting technicians to remote villages. Some private companies have solved the problem by training local residents; there is limited evidence that theft and vandalism is curbed by investing residents with a sense of ownership in the infrastructure.

This leads to a redefining of the quality of electricity. Not only is clean power, i.e., frequency- and voltage-stable, important, but more important is the duration that power is available.[26] It is common for a village to have only a few hours of stable electricity per

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[24] Palit and Sarangi, *Renewable Energy-Based Rural Electrification,* 15.

[25] Palit and Sarangi, *Renewable Energy-Based Rural Electrification,* 25.

[26] Sunila S. Kale, *Electrifying India: Regional Political Economies of Development*, (Stanford: Stanford, 2014), 177.

day, or even none at all.[27] Under the current *Rajiv Gandhi Grameen Vidyutikaran Yojana* (RGGVY) scheme, states are required to provide at least 6–8 hours of electricity per day to the electrified villages.[28]

C. SOUTH AFRICA'S ELECTRIFICATION EXPERIENCE: A COMPARATIVE BASE LINE

South Africa provides a helpful comparative case study against India due to their shared colonial histories and their divergence from autarkic policies. South Africa's geography differs greatly from India's with a lack of impassible mountain ranges coupled with political borders. However, the compositions of their populations in terms of the urban–rural divide are similar enough to warrant a comparison. While India has developed into an open-market economy with roughly 7% annual growth and $1,500 per capita GDP, South Africa's growth is a mere 1.6% but just over $5,000 in per capita GDP.[29] Part of this disparity can be explained by South Africa's aggressive electrification deployment in the years since 1994 when apartheid was abolished. This section examines South Africa's electrification experience in order to evaluate the technical and engineering aspects of power generation and distribution as well as the political considerations and dedication to infrastructure development.

Electrification of the hinterlands is an essential component of a state's transition from developing to developed. Modern states tend to follow a path in which the state makes significant investments in infrastructure in order to provide the best possible environment for its citizens' development. Put simply, investments in the welfare of the workers tends to yield higher productivity. South Africa's efforts to modernize its population not only includes maximizing the number of households with ready access to electricity but also increasing deployment of renewable sources.

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[27] Bhattacharyya, "Energy Access Problem," 3392.

[28] "RGGVY," Indian Power Sector, accessed April 2, 2016, http://indianpowersector.com/home/electricity-regulation/government-programmes.

[29] International Monetary Fund, *World Economic Outlook,* (Washington, D.C.: IMF, April 2013), 67. https://www.imf.org/external/pubs/ft/weo/2013/01/weodata/index.aspx.

For South Africa to meet the Millennium Development Goals (MDG) set at Johannesburg in 2002, substantial increases in electricity production and distribution must be made. The rural poor as a population are increasingly at risk of high illiteracy, poor fertility rate, and the twin evils of low life expectancy and high infant mortality.[30] South Africa, with its population of 45 million, is endowed with natural resources, including the coal and radionuclides necessary for energy production. Coal is the cornerstone of their energy and economy, supplying 91% of their electrical generation and 75% of their non-renewable demand, with nuclear power largely supplying the remainder.[31]

The institutions and policies of the National Party's apartheid regime were the primary barriers for electrification until the transition to democratic governance. Since the rural (read: mostly black) population was at best distrustful of the government in Johannesburg and unconvinced that the promises of the new government would come to fruition, the electrification project was directed by the national government without input from local communities.[32] As such, financing came the South African Government in cooperation with the primary energy company, Eskom. The initial phase of expansion from 1994 to 2000 was an explosion of development, with a doubling of electrified households, going from 35% to 71% and ultimately 84% in 2011, providing electricity to over 5.2 million households.[33]

The apartheid regime determined the direction of developmental progress and heavily influenced the energy industry, with the effect that electricity was provided to industry and white households, accounting for about 12% of the population. The ANC party that replaced the National Party in 1994 promised greater distribution with the

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[30] Bernard Bekker, A. Eberhard, T. Gaunt, and A. Marquard, "South Africa's Rapid Electrification Programme: Policy, Institutional, Planning, Financing, and Technical Innovations," *Energy Policy,* 36 no. 8 (2008): 3130.

[31] Ogunlade R. Davidson and Stanford A. Mwakasonda, *Southern Africa Sub-Regional Study: South Africa and Zimbabwe,* (Cape Town, South Africa: University of Cape Town, November 2003), 6. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.569.6130&rep=rep1&type=pdf

[32] "South African Electrification Programme," Global Network on Energy for Sustainable Development, http://energy-access.gnesd.org/cases/22-south-african-electrification-programme.html.

[33] Ibid.

"Access to electricity for all" campaign.[34] Unfortunately, this noble message was widely assumed to mean grid electricity. Key problems in generating greater electrical distribution include coal-based power is accompanied by non-trivial pollution, with long-term effects on respiratory health; electrification expansion programs constrained by access to funding; and severe inefficiencies in the distribution sector. More than 120 areas have less than 1,000 customers, resulting in low transmission efficiency, higher costs, and questionable fiscal viability of the utility companies; non-payment and electricity theft contribute to financial instability.

In order to combat this, three regulations were passed. The ANC established the National Electrification Programme (NEP), the National Electricity Regulator (NER), and the Reconstruction and Development Programme (RDP). The NEP, a government-funded initiative, had a singular goal of raising the percentage of electrified households to 66% by 2001, divided into 80% of urban areas supplied and 46% of rural regions.[35] The NER's mandate is to regulate the supply industry via licensing of generators, transmitters, and distributors throughout South Africa.[36] The RDP, meanwhile, established a national electrification target of 2.5 million households by the end of the 20th century.[37] South Africa's largest generator, Eskom, shared the government's goals and set an annual goal of 300,000 new households with an ultimate goal of supplying electricity to 1.75 million households.[38]

As with most government programs, funding was the limiting factor. Eskom largely funded the first phase when, in 2000, the National Electrification Fund (NEF) assumed responsibility. The NEF was financed largely through the public sale of government-owned industry assets as well as grants and tariffs. As the South African government decided that

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[34] Davidson and Mwakasonda, *Southern Africa,* 1.

[35] Ibid.

[36] National Electricity Regulator of South Africa (NERSA), *Energy Supply Statistics 2001,* 3. http://www.nersa.org.za/Admin/Document/Editor/file/News%20and%20Publications/Publications/Archived%20Issues/Electricity%20Supply%20Statistics/ESS2001_o.pdf.

[37] Ibid.

[38] Ibid.

electrification would be the fulfillment of socio-economic responsibility vice a commercial venture, Johannesburg passed the Electricity Basic Services Support Tariff (EBSST) in order to provide electricity, free of charge for up to 50 kWh per month, to the country's most destitute citizens.[39]

At the end of the National Party's reign, a mere 36% of the population had access to electricity.[40] By 2001, the NEP exceeded their original target by 1.35 million households, providing electrical access to more than 3.4 million since the NEP's inception in 1994.[41] A non-grid initiative was established to counter expected shortfalls in 1999. Initially, 350,000 solar home systems (SHS) was intended for installation in seven districts, but this was cut to six due to budget shortfalls. The SHS is designed to provide inexpensive, local electricity; the government subsidizes each unit at ZAR 3500 (USD 253) to the utility for each installed unit while the user pays a flat monthly fee of ZAR 58 (USD 4) for maintenance.[42] The system provides only 50Wp, but it is enough to power four lights, a radio, and a black and white television.[43] Table 1 illustrates the percentage of appliance ownership with respect to per capita income levels. The extremely poor have their service fee reduced to ZAR 18 (USD 1.26) via subsidy. These subsidies were provided through National Electrification Fund (NEF), a government-established fund with revenue supplied by the government, energy industry, and international grants, both public and private. To prevent, or at least reduce, opportunities for graft and corruption, annual progress reports on the NEP are published by the NER.

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[39] Global Network on Energy for Sustainable Development (GNESD), *South African Electrification Programme*, accessed July 12, 2016, http://energy-access.gnesd.org/cases/22-south-african-electrification-programme.html.

[40] NERSA, *Energy Supply Statistics 2001*, 1.

[41] Bekker, et al., "South Africa's Rapid Electrification," 3130.

[42] Ibid.

[43] GNESD, *South African Electrification Programme*.

Table 1. Percentage of South African Households with Electric Appliances, 2003[44]

	% of all households	% of households with per capita monthly income of:		
		<ZAR 130	ZAR 130–270	>ZAR 270
Hotplate	37	10	27	53
Kettle	32	12	25	65
Refrigerator	43	12	28	65
Television	47	19	33	67
Radio	87	79	85	91

The EBSST, enacted in 2002, has not only subsidized basic electricity needs but also enabled the development of non-grid electricity. Taking the form of solar home systems (SHS), the non-grid program was intended to target those destitute homes that were too far from the grid to make connections practical. For a nominal (and highly subsidized) fee, households were provided with a solar energy system and paid a monthly fee for routine maintenance. However, the SHS deployment has met with criticism as not only do SHS require higher operating costs, but the maintenance requires specialized training that is in short supply. Theft, vandalism, and lack of roads have also been noted.[45] Proponents have pointed out that, among other benefits, access to electricity has improved the health of the poor by replacing the burning of fuel indoors along with efficient electric cooking.[46] Advocates also argue that costs are irrelevant as electrification is a social responsibility and long-term investment.

Despite the progress by the turn of the century, Johannesburg expanded their ambitions, announcing a new goal of providing free basic water and electricity to the most

[44] Adapted from Ogunlade Davidson and Stanford A. Mwakasonda, "Electricity Access to the Poor: A Study of South Africa and Zimbabwe," *Energy for Sustainable Development,* 8, no. 4 (2004), 33. Doi: 10.1016/S0973-0826(08)60511-6.

[45] Bekker, et al., "South Africa's Rapid Electrification Programme," 3130.

[46] K. R. Smith, "Indoor Air Pollution in Developing Countries: Recommendations for Research," *Indoor Air,* 12 (2002), 198. Doi: 10.1034/j.1600-0668.2002.01137.x

destitute of its citizens.[47] The initial power rating was set at 50kWh per month for two reasons: first, slightly more than half of the currently connected households consumed less than 50 kWh per month on average and second, it was calculated that 50kWh per month was sufficient to provide lighting, cooking, and radio or television.[48] Meeting these basic needs, and thereby relieving the burden on the poorest of their people, was viewed as a moral necessity. Success can be measured by comparing the energy consumption of average household appliances to the ownership rate of the same.

The EBSST was intended to provide 50 kWh per month but that allows no overhead for appliances beyond what was calculated. Table 2 provides a matrix of appliance wattage and calculated monthly totals. Using, for example, a hotplate would push residents past the 50 kWh per month limit. There are other options and homes are not limited to exclusively electrical appliances. Encouraging the use of compact fluorescent (CFL) or LED lightbulbs, for example, would reduce the electrical load by 21–26 kWh each month. (CFL: 15W, LED: 1.5W) Shifting to a LNG stove would further reduce the demand, though it is uncertain whether LNG fuel, including transportation, is cheaper than electricity.

Table 2. Consumption of Electricity by Household Appliances, 2003.[49]

Appliance	Units	Consumption (W)	Hours used/day	Units/Month (kWh)
Light bulbs	3	60	5	28
Television	1	50	6	9
Radio	1	6	4	1
Hotplate	1	1000	1	31
Kettle	1	1000	0.25	8

[47] *Annual Report 2004*, South Africa Department of Minerals and Energy, 25. http://www.gov.za/sites/www.gov.za/files/dme04_05_0.pdf.

[48] Trevor Gaunt, "Researching a Basic Electricity Support Tariff in South Africa," *Domestic Use of Energy Conference,* (Cape Town, Cape Technikon, 2003), 31 http://www.uct.ac.za/mondaypaper/archives/?id=2888.

[49] Adapted from Davidson and Mwakasonda, "Electricity Access to the Poor," 33.

The success of non-grid solutions has not met with the same levels of success. The SHS photovoltaic modules have previously met with high failure rates, fundamental technological issues, and other concerns, most notably theft for harvesting the semiconductor material and copper. Modern designs have greatly improved in the intervening years and are worth revisiting. However, SHS are designed primarily to provide sufficient power for lighting, while studies show that the highest priority for the poor is power for cooking and water heating.[50]

Rural electrification is heavily subsidized through the National Electrification Fund. The subsidies are largely funded through the EBSST and allocates up to 50 kWh per month for destitute homes. Approximately 20 kWh provides power for cooking while the remainder equates to the energy required for three lights for four hours per day and one radio for 16 hours per day.[51] Emphasis has been placed on renewable energy, as in the SHS, but also with geothermal and wind, particularly in remote or isolated areas. Terrain and topography further complicate deployment, as the lack of roads and other infrastructure only increases the cost of installation and maintenance. The government accepts these transaction costs as part of meeting its socioeconomic obligations; in many cases it is impossible to recover operating costs to supply a rural customer.[52]

Eskom and the government recognize the value of renewable energy in rural areas. The modular nature of SHS and other renewables make them particularly well suited for isolated locations; systems, and therefore investment and capital, can be easily planned. The diversity within the non-grid system also bolsters energy security via immunity to petroleum price shocks. Biofuel (e.g., bagasse) is also renewable in addition to wind and hydro projects.

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[50] Ogunlade R. Davidson and Stanford A. Mwakasonda, "Southern Africa sub-regional study: South Africa and Zimbabwe Electricity access sub-theme." *Energy for Sustainable Development*, 7 (November 2003), 25. https://www.researchgate.net/profile/Stanford_Mwakasonda/publication/242180197_Southern_Africa_sub-regional_study_South_Africa_and_Zimbabwe_Electricity_access_sub-theme/links/0f31753b3d1fe4c27b000000.pdf.

[51] United Nations Economic Commission for Africa, *Making Africa's Power Sector Sustainable*, (Addis Ababa: UNECA, September 2007), 83. http://www.un-energy.org/sites/default/files/share/une/powersectorreport.pdf.

[52] Ibid.

South Africa made significant strides in nuclear power during the 2000's, particularly with respect to pebble bed technology. The pebble bed modular reactor (PBMR), rated at 100MW, was approved by the government for export with China, Japan, the United States, and the United Kingdom as potential customers, but was ultimately mothballed in 2010 due to lack of investment. The government was careful to note that the technology is sound and the decision was purely financial.[53]

With the high level of electrification within the country, efforts are underway to improve the efficiency of the generation and distribution chains. Self-contained multi-socket outlets known as ready boards have proven suitable for use in any type of home (including mud huts and cinderblock homes) and provide savings of 75% when compared to internal wiring.[54] Ready boards combined with prepaid metering schemes are now used extensively in the country. Other engineering techniques, such as transformer distance and load limiters, further improve efficiency by decentralizing the system and therefore eliminating costs-of-scale.

While electrification has spread beyond South Africa, leading to the power-sharing scheme within the South African Power Pool, the combination of South Africa's political history combined with an established, modern industry and decisive political will makes replication in other countries somewhat limited. Political institutions, technological modernization, and social benefits of electrification can be exported into other developing countries. Connection to grid power is the most common means of electrification, but it is also the most expensive. Geography frequently makes decentralized, or non-grid, power more attractive, as it eliminates the need for transmission lines and other infrastructure. Electrification of remote areas continues but at a much slower pace, as the easiest and cheapest areas to energize have already been serviced. Efforts to reach the truly isolated areas, while expensive, have not been abandoned by the government in their goal to completely power the country.

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[53] "SA Mothballs Pebble Bed Modular Reactor," Brand South Africa, 17 September 2010, http://www.southafrica.info/news/pbmr-mothballed.htm.

[54] Davidson and Mwakasonda, "Electricity Access to the Poor," 105.

As more homes have access to electricity, response to the EBSST has been overwhelmingly positive. Specific benefits have been noted: ability to cook more efficiently; lighting provides opportunity to study textbooks or read newspapers; reduced indoor air pollution thanks to fuel substitution; expand lighting to other, previously unlit, rooms; and greater media and news access (longer use of television and/or radio).[55]

D. CONCLUSION

This chapter explored the engineering and economic challenges inherent in rural electrification schemes and considered grid vice non-grid solutions for a given geography. Geographical conditions are important determinants of electrification solutions; remote populations may simply be physically distant from urban centers, relatively easily serviced by a grid system. Other villages may be geographically isolated by impassible terrain and better served by a microgrid or local generating station since extending grid services would be prohibitively expensive. South Africa's research into alternative generation schemes was based on the appropriate solution for a given community; while there is some amount of preference in any government endeavor, the post-apartheid culture was powerful enough to ensure the proper technological remedy without untoward political influence. India continues to struggle with expectations of favored constituencies and encourages pursuing the solutions developed by political clients rather than what may be in the best interest of the communities.

South Africa's electrification experience was examined in depth as a case study to compare against India's ongoing schemes. The abandonment of apartheid was the catalyst by which major institutional and structural reforms were possible and the expansion of electrical power enabled rural citizens to enter into the modern labor force. Johannesburg desired a complete and utter break from the culture of apartheid, thus clearing the way for more progressive policies, attitudes, and institutions that govern the production and delivery of electricity and other public goods. The next chapter delves into India's institutions and infrastructure in order to determine the relationship between socio-political structures and infrastructure development.

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[55] Bekker, et al., "South Africa's Rapid Electrification," 3130.

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III. THE DISTRIBUTIVE POLITICS OF ELECTRIFICATION IN INDIA

Economics are not immune to the vagaries of political relationships. India's history, particularly those under colonialism, greatly color the current state of institutional behavior. Acemoglu and Robinson explored this colonial legacy and found that British colonizers erected so-called "extractive institutions" that consisted of the dichotomy of the control of the local population as well as extracting rents from them.[56] This chapter briefly explores colonial and pre-colonial history as a lens through which post-independence class warfare and the eventual politics of public goods can be analyzed. This discussion then leads into an evaluation of the evolution of the rural electrification programs embarked upon by the Indian government culminating in the current scheme. India's colonial experience greatly influenced their institutional development after independence and, despite efforts at reform, continue to be felt today. Electrification in particular was viewed with skepticism by some of India's early leaders. Analysis of India's rural electrification projects in this context builds to the argument that India's initial centralized planning system contributed to a culture of corruption and patronage that delayed rural electrification and currently affects the distribution of power throughout the country.

A. COLONIALISM AND INDEPENDENCE

India, as a country, had been composed largely of six warring kingdoms until the introduction of the British East India Company. Britain chose from three different governing methods for each province: landlord, or *zamindari,* individual cultivator, *raiyatwari,* or village-based, *mahalwari,* with the goal of maximizing revenue to the crown while maintaining stability in the colony.[57] Language presented a barrier, however, when attempting to make an informed decision. When the British chose to establish a landlord in

[56] Daron Acemoglu and James A. Robinson, *Why Nations Fail,* (New York: Crown Business, 2012), 271.

[57] Abhijit Banerjee and Laskhmi Iyer, "History, Institutions, and Economic Performance: The Legacy of Colonial Land Tenure Systems in India," in *Essential Readings in Comparative Politics,* ed. Patrick H O'Neil and Ronald Rogowski, (New York: W. W. Norton, 2013), 161.

Bengal, for example, they did so largely because they found landlords already established. What was not apparent was that these "landlords" were merely tribal chiefs and not the industrial-scale agriculturalists that Britain assumed.[58]

The differences in governance between the *zamindari* and *raiyatwari* areas were not insignificant. The peasants in zamindari areas were largely under the control of the landlords who were empowered to extract taxes with impunity. When contrasted with the contractual relationships found in *raiyatwari* and *mahalwari* areas, investments in development foundered in *zamindari* areas, likely due to a fear that any returns would be expropriated by the landlord.[59]

Banerjee and Iyer further discuss, like other scholars, that resentment of the landlords by the peasants resulted in a post-independence political environment that sought to reverse the direction of extraction. Political mobilization of the residents led to a form of class warfare that focused on resource extraction from the wealthy rather than the development of public goods, e.g., electricity.[60] A form of political inertia was formed whereby the elites were forced to address or resist the activism rather than invest in development, although their history of self-enrichment renders the idea that they would focus instead on development charitable at best. The non-landlord areas, by contrast, enjoyed investment in public goods by the colonists; while gains could be extracted, they were governed by contract and law rather than caprice. This is shown by the fact that non-landlord areas possessed arguably better public goods and a much better political environment than in zamindari areas.[61]

India's colonial experience was unique in that the states were governed differently; some districts were governed by a landlord while others let the villages or even, in some cases, individual cultivators manage their own affairs.[62] Despite the intention of the British

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[58] Banerjee and Iyer, "History, Institutions, and Economic Performance," 164.

[59] Ibid.

[60] Ibid.

[61] Ibid., 161.

[62] Ibid.

to maximize the Crown's revenue while maintaining colonial stability, inequality became rampant among the landlord districts. This set the tone for post-colonial elections where class warfare ensued, with wealth redistribution and rent collection prioritized while leaving public goods and infrastructure to languish.[63]

This class warfare gave rise to widespread corruption best characterized by Easterly's "centralized" corruption and, ultimately, the style of patrimonialism practiced in India today.[64] Easterly also identified "opportunities for graft" as the primary motivation for perpetuating bad policies and prescribed quality institutions and anti-corruption policies as methods for minimizing the damage.[65] Inequality swiftly became rampant among the landlord districts, extending into the mid-20th century. Uttar Pradesh, the most populous province of India, had a mix of landlord districts (25%) and non-landlord (75%). The landlords, as the sole authority for revenue collection and distribution, controlled a large proportion of revenue and a correspondingly high measure of inequality.[66]

Contemporary politics in India is an extension of the country's colonial experience and a complicated affair, heavily driven by caste, language, religion, and class. Three political parties currently form the power base in contemporary UP: the Bahujan Samaj Party (BSP) mobilizes lower-caste voters, while the middle- and upper-class largely support the Bharatiya Janata Party (BJP), a Hindu-nationalist party.[67] The Samajwadi Party (SP) is made up of the large number of Muslim and Other Backward Class (OBC) members.[68] The rise of the BSP and its emphasis on policies that favor lower-income residents has improved rural electrification within UP, but the fact that India has separated construction of electrical infrastructure from actual power distribution indicates that electricity is controlled by political actors rather than a static public good. As Brian Min

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63 Banerjee and Iyer, "History, Institutions, and Economic Performance," 163.

64 William Easterly, *The Elusive Quest for Growth,* (Cambridge, MA: MIT, 2001), 247.

65 Ibid., 252.

66 Banerjee and Iyer, "History, Institutions, and Economic Performance," 165.

67 Min, *Power and the Vote*, 127.

68 Ibid., 127.

states, "it is often said that Indian politics centers around *bijli, sadak, paani* (electricity, roads, water)."[69] These social divisions reflect the amount of public goods that are able to be extracted; BJP-dominated areas historically tend to have better access to public goods while OBC districts typically languish.[70] Banerjee and Somanathan contend that this is largely due to a relationship between land ownership and political power. Since the elites in the BJP derive a large part of their wealth through property, they have an outsized impact on the production and delivery of public goods.[71]

Electrification after independence was a contentious subject; Gandhi was skeptical and feared that electricity would obviate traditional lifestyles and livelihoods.[72] The Nehru administration, however, disagreed and considered electrification as an essential prerequisite for industrialization and modernity.[73] Pre-independence leaders favored the import substitution industrialization (ISI) strategy that was in vogue due to it supposed ability to rapidly industrialize countries. Like Gandhi, Nehru was unconvinced that the economy could be entrusted to private enterprise and so promoted an environment in which heavy industry would spur economic development for the benefit of all.[74] Passed shortly after independence, the Electricity Act of 1948 provided that all power generation would be controlled by the state. State Electricity Boards (SEB) were created and, by 1991, controlled more than 70% of generation and nearly all of distribution. This monopolization removed competition and therefore the impetus for deterioration in service and infrastructure.

The reforms of the early 1990s were far more comprehensive than those in the 1960s and again in the 1980s, but due to the global economic downturn in 1991, efforts

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69 Min, *Power and the Vote*, 130.

70 Abhijit Banerjee and Rohini Somanathan, "The Political Economy of Public Goods: Some Evidence From India," *Journal of Development Economics,* 82, 2007, 289. doi: 10.1016/ j.jdeveco.2006.04.005.

71 Ibid.

72 Kale, *Electrifying India*, 28.

73 Ibid.

74 Atul Kohli, *Poverty Amid Plenty in the New India,* (Cambridge University Press: Cambridge 2012), 83.

were thwarted by a perception that they were directed by the IMF and World Bank.[75] This perception was incorrect and largely based in the fear that such reforms would be reversed after the economy improved, though the economic boom that followed in 1994–1997 established a credibility that had been absent, as Indian GDP grew at an average rate of 5.4% per year as shown in Table 3.[76] Following the 1991 financial crisis, the economic framework was profoundly reformed, including trade liberalization, industrial and electrical deregulation, opening to foreign direct investment (FDI), and other financial modifications.[77] Delhi realized that electricity enables the establishment of significant public goods such as schools and medical clinics. Improved services lead to a more productive workforce thus contributing to economic growth. The subsequent growth rate coupled with relative increases in development encouraged Delhi to invest more heavily in the Indian population, particularly with respect to electrification. While government leaders increasingly saw a correlation between access to public goods and increased development and economic growth, public goods could not exist without access to reliable electricity. Socio-economic divisions within the country are centuries-old but significant progress has been made to reduce the inequality in terms of electrification and other public goods.

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75 Arvind Virmani, "India's Economic Growth: From Socialist Rate of Growth to Bharatiya Rate of Growth," (working paper 122, Indian Council for Research on International Economic Relations, February 2004), 23.

76 World Bank, *India Development Update,* 13.

77 Ibid.

Table 3. Per Capita Income vs. Growth Rate.[78]

State	Per Capita Income, 2006–7	Population	Avg. Growth Rate 1990–2008
Haryana	37.3	25.4	7.5
Maharashtra	31	112.4	6.7
Kerala	30	33.4	6.7
Punjab	30	27.7	4.5
Tamil Nadu	28.3	72.1	6.6
Himachal Pradesh	28.6	6.9	6.9
Gujarat	27	60.4	8.8
Karnataka	23	61.1	7.4
Andhra Pradesh	22.8	84.7	6.4
West Bengal	21.8	91.3	7.2
Rajasthan	16.5	68.6	5.8
Orissa	15.5	41.9	5.1
Assam	15.2	31.2	3.5
Madhya Pradesh	12.9	72.6	4.8
Uttar Pradesh	11.3	199.6	4.3
Bihar	8.2	5.7	103.8

B. POST-INDEPENDENCE DISTRIBUTIVE POLITICS

In the elections following independence, the peasant class predictably engaged in anti-landlord voting and vice-versa. In this section of class warfare, the poor sought to extract benefits and reform from the wealthy over demanding public goods and infrastructure from the state. Public goods further languished as rural elites were largely concerned with rent-collection instead of pressuring state agencies to provide infrastructure and resources that the farmers needed.[79]

Non-landlord areas, by contrast, received significant state funding because the colonial government was able to set rates. State investment in infrastructure enabled the

78 Adapted from: Economic and Statistical Organization Government of Punjab, *Statewise Data*, (Chandigarh: Economic and Statistical Organization, 08 January 2018), http://www.esopb.gov.in/Static/PDF/GSDP/Statewise-Data/StateWiseData.pdf.

79 Virmani, "India's Economic Growth", 63.

state to increase its revenues. Uttar Pradesh had a mix of landlord (25%) and non-landlord (75%) districts and yet continues to show divergence even after independence.[80] The extractive policies of the landlords were not adopted by the state, although it is far from clear that state elites do not abuse their position for private gain.[81] Indeed, the policies of *garibi hatao,* "abolish poverty," were intended to generate political capital but policies that benefitted lower classes were rarely pursued.[82] As a result, Congress lost seats in favor of lower-caste parties such as the BSP and SP in 1989.

In the current political climate, politicians affect access to basic public goods by undue influence on bureaucrats who enjoy employment at the politicians' sufferance.[83] Electrical power distribution is essentially a balanced equation. The amount of power generated must be close to the amount consumed; if either too much or too little power is taken at any one node in a grid system (or if too much/too little power is generated) the grid will likely collapse with the outage spreading beyond state borders. This load imbalance was the cause of the outage affecting a large part of northeastern India in 2012. Politicians place great pressure on the operators to meet promises rather than ensure a stable grid.[84] This pressure extends to job security; investigations have found that politicians pack the utilities with favored clients and are not hesitant to replace or transfer those who displease their patrons.[85]

This has changed the fundamental calculus of public goods: rather than producing goods that stimulate health and development, private goods are instead produced for those with political connections. This assertion is supported by Abhijit Banerjee who conducted a study to determine how public goods were distributed. Banerjee's conclusion was "…that access to public goods is substantially a matter of who can extract them from the political

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80 Virmani, "India's Economic Growth," 18.

81 Acemoglu and Robinson, *Why Nations Fail,* 271.

82 Atul Kohli, *State-Directed Development: Political power and Industrialization in the Global Periphery,* (New York: Cambridge University Press, 2004), 281.

83 Ibid., 128.

84 Kale, *Electrifying India*, 177.

85 Min, *Power and the Vote*, 131.

system."[86] Banerjee expands on this, positing that that a lack of public goods becomes a vicious cycle; elites flee underperforming villages in favor of developed cities. This flight results in a lack of leadership in villages as well as a stop in infrastructure funding; very little point funding a clinic or school if there are no physicians or teachers.[87] Additionally, Anusha Nath concluded that the lack of voter accountability leads to a higher probability that politicians will allocate resources to projects favored by their wealthy constituents.[88]

Institutionalized favors to the politically connected and other elites runs counter to the modern concept of the rule of law. Institutional health ensures that elites/preferred groups do not exploit the economy for personal gain or, more perniciously, to repress a relatively powerless subset of the population. Neopatrimonialism perhaps best describes the conditions, where a patron-client relationship exists between the population and the ruling class, producing private goods for those in power instead of public goods for trade, expansion, and growth.[89] As Kohli points out, government actors are not typically motivated by any definition of "public good" and, indeed, center around personal interests or establishing patronage relationships to ensure continued political power.[90]

Selling public goods for private enrichment—rent-seeking—occurs on two different scales: grand and petty. Petty corruption is essentially direct bribery from those without power to those that do. Grand corruption, the type most commonly seen in electrification schemes, arises from bureaucracies attempting to privatize utilities in one form or another or by attempting to use one resource to bolster private economies, as later discussed in the explosion of biofuel and bagasse in Maharashtra. This is not to say,

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86 Abhijit Banerjee, *Who Is Getting the Public Goods in India: Some Evidence and Some Speculation*, (Cambridge, MA: Massachusetts Institute of Technology, April 2002), https://economics.mit.edu/files/8940.

87 Ibid.

88 Anusha Nath, *Political Competition, Public Goods Provision and Project Implementation*, (Boston, MA: Boston University, 2015), https://open.bu.edu/bitstream/handle/2144/15996/Nath_bu_0017E_11338.pdf?sequence=1&isAllowed=y.

89 Larry Diamond, "The Rule of Law Versus The Big Man," in *Essential Readings in Comparative Politics,* ed. Patrick H. O'Neil and Ronald Rogowski, (W.W. Norton: New York), 300.

90 Kohli, *Poverty Amid Plenty*, 153.

however, that rents from contracting are the only reason bureaucrats may wish to ally with private enterprise.

Rufin, et al. provide three reasons for involving government with electrification: limitations of private investors or companies, rent limitations or appropriations, and natural monopolies.[91] Electrification in general—and rural in particular—relies on skills and specializations not readily available in government but easily found in private industry.[92] Corruption and rent-seeking, however, require not only institutions that are amenable to such exploitation, but also bureaucrats skilled in manipulation of people and resources. Petty corruption is rampant where Diamond's strong men offer to sell illegal power connections or bribe officials to allow such connections.[93] In some cases, such corruption extends into organized crime, which prevents engineers and auditors from enforcing regulations.[94] Meanwhile, Hansen and Bower state that electrical engineers benefit from subsidy fraud; by over-reporting consumption by subsidized classes, such as agriculture, engineers are able to keep the difference.[95]

Jennifer Bussell posits that a circular power structure exists due to the extent of petty corruption and bribery.[96] Citizens require services from both politicians, for whom they vote, and bureaucrats to whom they pay bribes for expeditious and timely service. Bureaucrats, for their part, collect bribes as a matter of course to help prioritize. However, they also suffer from rent-seeking politicians, who are in turn forced to not only finance their own campaigns but deliver on the services promised to their constituents. Bussell uses this model as an informal institution to illustrate the demands—and therefore constraints—

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91 Carlos Rufin, U. Srinivasa Rangan, and Rajesh Kumar, "The Changing Role of the State in the Electricity Industry in Brazil, China, and India," *American Journal of Economics and Sociology,* 62 no. 4, October 2003, 650. Doi: 10.1111/1536-7150.00239

92 Jennifer Bussell, *Corruption and Reform in India*, (Cambridge: New York, 2012), 47.

93 Diamond, 300.

94 Christopher Joshi Hansen and John Bower, *Political Economy of Electricity Reform: A Case Study in Gujarat, India,* September 2003, Oxford Institute for Energy Studies. https://www.oxfordenergy.org/wpcms/wp-content/uploads/2010/11/EL03-PoliticalEconomyofElectricityReformACaseStudyofGujaratIndia-ChristopherHansen-2003.pdf

95 Ibid., 26.

96 Bussell, *Corruption and Reform in India,* 47.

placed on citizens, bureaucrats, and politicians and the relative self-interest inherent in this structure, depicted in Figure 3.[97]

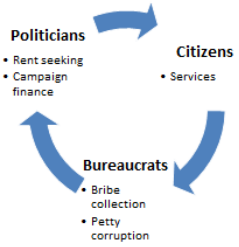

Figure 2. Circular Power Structure within Indian Bureaucracy

The state of Maharashtra is an example of politicized electrification attempts. The commitment to agricultural growth was the prime mover for electrification with the result that communities that were electrified gained considerable political power. This relationship begat a system of cross-subsidies between electricity, fertilizers, and prices; promoting electrical generation through bagasse (biofuel, specifically, sugar cane pulp) came to be seen as a way of not only preserving the subsidy system but also a boost to the agriculture industry.[98] Electrical generation became politicized because it increased revenue streams to politically connected institutions. Despite the graft and rent-seeking, expansion of electricity became a prime goal in Indian politics.

C. THE EVOLUTION OF ELECTRIFICATION PROGRAMS IN INDIA

The Government of India, or GoI, concluded that electrification is a symbol of progress if not a social obligation, despite the fact that electrification of the hinterlands is

[97] Bussell, *Corruption and Reform in India,* 256.

[98] Ibid., 67.

financially non-viable.[99] The GoI learned, however, from the example of other countries in that while grid electrification is prohibitively expensive, other options are available. Indeed, the efforts of the Indian government since 1997 has produced several schemes in which the national government attempted to provide electrical power to the hinterlands. Rather than provide reliable power to everyone through a centralized grid, electrical power can be provided to rural communities through a scheme of decentralized sources or, in extreme cases, individual households can be powered through modular electrical systems.

Indian planners came to realize that the neopatrimonial system is incompatible with effective electrification. Several policy initiatives have attempted to further extend the grid but these approaches ignore the fact that a centralized grid is too expensive given the country's topography.[100] As evidenced in the South African experience, distributed networks provide the best compromise of efficiency, affordability, and honesty. Theft of electricity, whether by meter manipulation or by criminal theft is a serious consideration when deciding how to proceed with respect to expansion of the electrical grid.

Indian power bureaucracy starts at the state electricity boards (SEB), which own the interstate power lines and are responsible for power generation, transmission, and distribution. Overall planning and policy are set by the Ministry of Power (MoP) and the Central Electricity Authority (CEA). Initially, agricultural interest groups cultivated their political influence, yielding lucrative subsidies. These subsidies also tended to enrich urban elites, a key demographic that politicians require to remain in office. Subsidies for rural electrification are frequently met with skepticism in the literature, with many scholars noting that such schemes start with an attempt to alleviate poverty but ultimately become

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[99] Sanjeev H. Kulkarni and T.R. Anil, "Rural Electrification Through Renewable Energy Sources – An Overview of Challenges and Prospects," *International Journal of Engineering Research,* 3, no. 6, June 1, 2014, 388, http://citeseerx.ist.psu.edu/viewdoc/download;jsessionid=BB3FBF9B1F118B606202ACD83C5016B0?doi=10.1.1.678.2666&rep=rep1&type=pdf

[100] Ibid.

self-enrichment schemes for elites.[101] Rehman et al. note that subsidy reform is quite difficult due to the fact that attempts require the support of the same elites that the subsidies benefit. The IEA indicates this is a valid supposition, since, on a global scale, only 8% of the total spent on energy subsidies was spent on the lowest 20% of the population.[102]

Subsidies are generally split between low-income families and agricultural concerns. World Bank studies show that while low-income households pay up to half the cost of their electricity, farmers receive the lion's share of subsides, paying a mere 10%.[103] Fuel is likewise subsidized for those reliant upon household or village generators, but Rao writes that subsidized kerosene is resold on the black market.[104] These subsidies tend to negatively impact not only the intended beneficiaries but the economy as a whole. Fuel is diverted either as adulterants (e.g., motor fuel), while electricity subsides use connections as a metric instead of actual power provided. The result is that the power generators are forced to absorb the cost when the global oil market shifts.

Many argue that the Green Revolution was the prime mover for electrification, but the definitions proved problematic. Perhaps in an attempt to boost progress metrics, a village was considered to be electrified, for example, if a transformer was placed in it.[105] Naturally, the mere physical presence of infrastructure is only half of the picture; actual electricity must flow. While the Electricity Act allowed private ventures, the Ministry of Power (MoP), through the Rural Electrification Corporation Limited (REC) retained authority, oversight, and, when needed, financial assistance for each program.[106] GoI has

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101 I.H. Rehman, Abhishek Kar, Manjushree Banerjee, Preeth Kumar, Martand Shardul, Jeevan Mohanty, and Ijaz Hossain, "Understanding the Political Economy and Key Drivers of Energy Access in Addressing National Energy Access Priorities and Policies," *Energy Policy,* 47, (June 2012): 32, doi: 10.1016/j.enpol.2012.03.043.

102 IEA, *Joint Report on Fossil Fuel and Other Energy Subsidies,* 6.

103 World Bank, *Agriculture Investment Sourcebook,* (Washington, D.C.: World Bank, 2003), http://documents.worldbank.org/curated/en/633761468328173582/pdf/343920PAPER0Ag101OFFICIAL0USE0ONLY1.pdf

104 Rao, N.D. "Kerosene Subsidies in India: When Energy Policy Fails as Social Policy," *Energy for Sustainable Development,* 16, no. 1 (March 2012): 41, doi: 1.1016/j.esd.2011.12.007.

105 Kulkarni and Anil, "Rural Electrification," 386.

106 National Informatics Centre (NIC), Ministry of Power, Govt. of India, 2013, accessed 10 March 2016, http://powermin.nic.in.

struggled with numerous electrification schemes since independence, most notably the *Kutir Jyothi Program* (KJP), the Minimum Needs Program (MNP), the Rural Electricity Supply Technology (REST), and the *Rajiv Gandhi Grameen Vidyutikaran Yojana* (RGGVY).[107] Table 3 provides a chronological list of the electrification schemes.

Table 4. Rural Electrification Schemes

Scheme	Year Enacted	Challenges
Kutir Jyothi Program (KYP)	1988	Subsidies, theft, default
Rural Electricity Supply Technology (REST) Mission	2002	Impassible terrain, high up-front costs
Electricity Act	2003	Regulatory constraints
Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY)	2005	Subsidies, loans, misleading metrics
Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY)	2015	Funding, misleading metrics

1. Kutir Jyothi Program (KYP)

The *Kutir Jyothi Program* (KJP), or "Bright Home Program," in 1988 established a goal of providing single-point light connections to all households in the country who lived below the poverty line with the program financing the entire enterprise, including last-mile costs such as internal wiring.[108] The Minimum Needs Program, designed to supplement the KJP, concentrated efforts in areas that that suffered electrification rates of less than 65% by providing last-mile costs such as internal wiring.[109] The performance of

[107] Bhattacharyya, Subhes C., "Energy Access Problem of the Poor in India: Is Rural Electrification a Remedy?" *Energy Policy* 34 (2006): 3393, doi:10.1016/j.enpol.2005.08.026.

[108] Kulkarni and Anil, "Rural Electrification," 387.

[109] Ibid.

the MNP, like the KJP, was lackluster and ultimately discontinued. Programs that followed met similar fates.

The KJP suffered from four fatal flaws: electricity leakage, subsidies, defaults, and loans.[110] Utilities frequently received government loans for rural electrification and were therefore shouldered with the burden of repayment and interest. Repayments were further hampered by the fact that customers frequently found themselves in arrears, both because the customers simply couldn't afford to pay their bill and poor bookkeeping practices by the utilities. Customers failed to pay their bills even though the government heavily subsidized their rates. For example, regulatory commission of the state of Karnataka set a 19% tariff on the cost of supply, forcing the utilities to take a lower payment from the government than what was actually charged.[111] These subsidies, like the one in Karnataka, fell below the cost of electrical generation leading several power companies to operate at a loss. The final burden, theft, figured most prominently as a "Swiss-cheese" model.[112] As electrification expanded, new customers were added to a grid approaching its saturation point. Low-voltage power lines were added, rather than high-voltage, due to cost; such improper wiring led to unavoidable transmission losses. Connections were also often added without providing a meter as bureaucrats vice engineers determined what a household was likely to consume and tied that to an established subsidized price-point. The lack of metering as well as improper wiring increased potential for corruption at the customer level; theft via additional connections, overuse, or tank circuitry increased greatly but only through empirical evidence as the utilities were unable to discern between line losses and theft.[113]

The confluence of subsidies and tariffs—funded by the federal government and administered by state governments and utilities—along with the patchwork of

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[110] Kulkarni and Anil, "Rural Electrification," 387.

[111] Ibid.

[112] In modern aviation, crashes and other incidents are almost always the result of several missed opportunities for crew and controllers to avoid the mishap. This risk analysis model has been extended into other industries and is referred to as the "Swiss cheese model." See https://en.wikipedia.org/wiki/Swiss_cheese_model.

[113] Bhattacharyya, "Energy Access Problem," 3392.

supplemental programs, ultimately created an environment in which consumers were caught between the competing interests of utilities attempting to remain solvent and politicians who exerted undue influence on management decisions. In the late 1990s, senior leadership in Delhi began to establish rural electrification as a priority, responding to voter complaints. The KYP and associated programs were scrapped and replaced by the Electricity Act of 2003.

2. Rural Electricity Supply Technology Mission and the Electricity Act

In the 1990s, India was confronted with the need for additional power capacity estimated in thousands of additional megawatts. However, India's state-owned enterprises (SOE) were notoriously inefficient and beholden to political factions. Further, they operated with high deficits despite pressure to reduce costs. A sea change in development strategy occurred as elites began to believe that the greatest roadblock to increased development was the lack of financial capital. This was a shift from a central-planning scheme to market allocation, a key condition to boost investor confidence and an increase in FDI.[114] The World Bank provided the impetus in its new policy of promoting private investment and development in the energy sector, leading GoI to follow suit with the intention of separating electricity from election campaigns and other political considerations.[115] Indian states pursued this strategy with mixed results; some states, such as Orissa, ultimately failed in their privatization efforts while Delhi was relatively successful in privatizing distribution between Reliance Energy and Tata Power Company.[116] Depoliticization resulted in the creation of state electricity regulatory commissions (SERC) but one of the leading complaints against them is that the regulators are chosen from a pool of existing bureaucrats with close ties to politicians, leading to questions about the true independence of the SERC.

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[114] Kale, "Current Reforms: The Politics of Policy Change," 473.

[115] World Bank, *The World Bank's role in the electric power sector: policies for effective institutional, regulatory, and financial reform,* (Washington, D.C.: The World Bank, 1993), http://documents.worldbank.org/curated/en/477961468782140142/The-World-Banks-role-in-the-electric-power-sector-policies-for-effective-institutional-regulatory-and-financial-reform.

[116] Amol Phadke and Sudhir Cella Raja, "Electricity Reforms in India: Not Too Late to Go Back to the Drawing Board," *Economic and Political Weekly,* (19 June 2003) 3063.

The objective of the Rural Electricity Supply Technology (REST) Mission was to achieve total village electrification via decentralized renewable sources instead of relying solely on grid extension.[117] The novel use of non-grid technology promised to be cheaper than attempting to scale the grid model into difficult, if not impassible, terrain. At the time, however, such units had prohibitively expensive up-front costs despite the relatively low long-term maintenance and fuel costs due in large part to the required number of households to establish a minimum load.[118] Such small-scale units continued to be used, although in a peripheral role in village electrification.

India's pervasive bureaucracy renders the country unable to effectively implement stated policy goals and intentions. While the bureaucracy has created a sense of order and continuity, it is also prone to caste politics and rigid rules, hampering any attempts to change the status quo. According to Prime Minister Vajpayee, speaking in 2001, "the rigid mindset of the bureaucracy is obstructing the reform process."[119] Slow decision-making combined with punishment for mistakes without commensurate acknowledgment for success leads to bureaucratic careerism in which personal interests trump attempts at progress. The Central Electricity Authority (CEA), for example, has not been replaced or reformed despite requiring over a dozen clearances at the federal and state levels to approve an electricity project.[120] Efforts are further hampered by a lack of coordination due to constitutional separation and a lack of consistency by politicians who are either for or against reform depending on whether they are running for office or are already in office. Since this lack of consistency breeds a lack of legitimacy, reform policies lack the imprimatur necessary for implementation. In short, weak institutions and government has led to bureaucratic mismanagement, inefficiency, and corruption.

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[117] Debajit Palit and Akanksha Chaurey, "Off-Grid Rural Electrification Experiences from South Asia: Status and Best Practices," *Energy for Sustainable Development,* 15, no. 3 (September 2011), 268, doi: 10.1016/j.esd.2011.07.004.

[118] Ibid.

[119] Rufin, et al., "The Changing Role of the State," 662.

[120] Lawrence Saez, "A Comparison of India and China's Foreign Investment Strategy Toward Energy Infrastructure," *Journal of Developing Areas* 32, no. 2 (Winter 1998), 202.

GoI later enacted the Electricity Act of 2003 (EA2003), which greatly expanded grid sources while at the same time boosting renewable energy (RE) based off-grid systems through a series of local incentives.[121] The act was a paradigm shift away from central regulation and permitted private investment and power generation and transmission. Along with the private development, it decentralized rural electrification efforts down to local governments and private organizations along with eliminating much of the requirements for licensure. Financial responsibility provisions were also included, requiring anti-theft measures such as electrical metering and encouraging private investment in the form of independent power producers (IPP) to sell power to public utilities at market rates, ultimately making up roughly a quarter of India's total generating capacity.[122] These IPPs were driven by a desire by Delhi to remove politics from energy pricing; Rao and others attribute the decline of the power sector to not only poor administration but also a concern that populism distorted market prices.[123]

Consumer complaint offices were opened in an effort to protect customers. The creation of the Appellate Tribunal for Electricity (ATE) removed the need for lengthy and expensive trials, the only real recourse for complaints against the SEBs. The OECD provides for three pillars of governance: observance of shareholder rights; fiscal and operational transparency; and effective oversight.[124] Since the SEBs were beholden to their legislative patrons, however, there was little if any true accountability. Shareholder rights were routinely ignored as SEBs failed to provide any reasonable rate of return on investments, resulting in a negative net worth as well as decimating consumer confidence. However, poor governance and mismanagement continues to fester as illustrated by subsidies default to utilities, paperwork delays, and efforts to bypass the ERCs.[125]

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[121] Debajit Palit and Gopal K. Sarangi, *Renewable Energy-Based Rural Electrification: The Mini-Grid Experience from India,* United Nations Global Network on Energy for Sustainable Development, (United Nations: Copenhagen, 2014), 13.

[122] Surendra Laxminarayan Rao, *Governing Power: A New Institution of Governance, the Experience with Independent Regulation of Electricity,* (New Delhi: The Energy and Resources Institute, 2004), 82.

[123] Ibid.

[124] Organization for Economic Cooperation and Development (OECD), *OECD Economic Studies Special Issue: Regulatory Reform*, No 33, (Paris: OECD, 2001), doi: 10.1017/eco_studies-v2001-2-en.

[125] Rao, *Governing Power,* 91.

The EA2003 attempted to break the SEB monopolies but the process is delayed by routine granting of deadline extensions; central authorities were simply unwilling to accept the political and pecuniary risk incurred by the overall inability to address theft, vandalism, defaults, and supply shortages. The patronage relationship between government bureaus and utilities exacerbated the situation, leading to a perception amongst customers that there is a revolving door between government, SEBs, and utility leadership that leads to a sense of immunity—if not hostility—to regulatory reform even in the face of abysmal performance.[126]

Unfortunately, existing regulations hamstrung off-grid efforts, preventing companies from adapting as they needed. This was corrected by the passage of the National Electrical Policy in 2005 and the Rural Electrification Policy a year later.[127] The 2006 Tariff Policy highlighted the concerns regarding risk aversion, noting that while improvements in board governance ought to result in loss reduction, the political will to do so was non-existent. Delhi acknowledged at this point that rural electrification would not happen in any meaningful sense unless the entire enterprise was stripped of political chicanery.[128] However, the architecture of EA2003 created institutional conflict between the interests and authority of the state politicians, those at the national level, and the utilities. The SERCs suffered frequent interference from administrative bureaucrats and other government officials. Amendments to the EA2003 contributed to attempts to eliminate such meddling by reforming REST Mission programs and incorporating them into the new Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) scheme.

3. Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY)

The RGGVY is intended, like many other grand schemes, to achieve 100% village electrification by 2012, since extended to 2017.[129] The program codifies GoI's

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126 Rao, *Governing Power,* 88.

127 Palit and Sarangi, *Renewable Energy-based Rural Electrification,* 13.

128 Vijay Modi, "Improving Electricity Services in Rural India," (working paper, Center on Globalization and Sustainable Development, 2005), 26, http://web.iitd.ac.in/~pmvs/courses/rdl722/RuralEnergy_India.pdf.

129 Bhattacharyya, "Energy Access Problem," 3387.

commitment to supply 24-hour electricity to increase economic activity and health care. However, unlike previous schemes, this plan does not rely on grid expansion, decreasing opportunities for graft. Instead, as in the South African model, local generation eliminates the exorbitant "last mile" installation costs inherent in grid distribution. The RGGVY is an ambitious undertaking, with the central government shouldering 90% of the cost with the remainder supplied in the forms of loans.[130] The progress achieved by the RGGVY is substantial; over 72,000 villages were electrified between 2005 and 2010.[131] The stricter definition of "electrified" as well as the economically favorable terms provided by the RGGVY are commonly cited as the reasons for the increase in electrification. Previously, villages were "electrified" if any electricity was consumed for any reason. Under RGGVY, electrification must meet three criteria: at least 10% of households must be powered; infrastructure, e.g., transformers, must be established, protected, and upgraded as necessary; and public institutions, e.g., medical facilities, must be electrified.[132] Providing power to medical facilities is of critical importance, as many medicines and advanced diagnostic tools require electricity. Surveys have also shown that rural households tend to avoid clinics because of the lack of services when no power is available.[133]Electrical Subsidies

Recouping the costs of electrification in India becomes problematic, as 85% of the total cost is covered by collected tariffs. Subsidies cover roughly half of the bill for rural populations while paying for more than 90% for farmers.[134] The U.N. Environment Programme (UNEP) conducted a study in 2008 showing that farmers received subsidies totaling approximately USD6B per year, twice that of the spending allocated for rural

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[130] Bhattacharyya, "Energy Access Problem," 3395.

[131] Hisaya Oda and Yuku Tsujita, "The Determinants of Rural Electrification: The Case of Bihar, India," *Energy Policy* 39 (2011): 3089, doi: 10.1016/j.enpol.2011.02.014.

[132] Bhattacharyya, "Energy Access Problem," 3389.

[133] K.R. Smith and Y. Liu, "Indoor Air Pollution in Developing Countries," *Indoor Air* 12, no. 3 (September 2002): 201. PubMed.

[134] United Nations Environment Programme (UNEP), *Reforming Energy Subsidies: Opportunities to Contribute to the Climate Change Agenda,* 27. http://hqweb.unep.org/pdf/PressReleases/ Reforming_Energy_Subsidies2.pdf.

development.[135] Misuse of subsidized goods is likewise an issue, with subsidized kerosene, intended for lighting and cooking, is resold on the black market or repurposed, such as a vehicle fuel additive.[136] Elites advocated for the subsidies in the name of social justice but the true beneficiaries are the elites; subsidies are applied to the price of electricity by virtue of the consumers' identity and location vice income level. This has dire consequences for the public sector oil companies, as GoI's schemes are flat-rate and do not adjust to meet global market prices. From 2004–2011, for example, global oil prices surged without commensurate change in the subsidy rate, leading to a total revenue loss of nearly USD 10 billion in 2010.[137] The losses are relevant because it represents the cost of lost opportunities in oil exploration, improved technology for generation and transmission, and construction of new infrastructure.

Despite marketing campaigns promoting the virtues of subsidies, they are clearly not without risk. There are generally four consequences for poor subsidy management: subsidies can be diverted onto the black market, as seen in India's experience with kerosene.[138] Second, they can be misused or at least not used for their intended purpose, e.g., kerosene earmarked for cooking is instead used for lighting. Third, subsidies are meaningless if the actual product is unavailable. Under RGGVY, poor homes that live below the poverty line (BPL) receive free electricity, but blackouts are a fact of daily life. Finally, subsidies tend to be poorly targeted. Flat-rate schemes on fossil fuels in a net-importing country frequently leads to oil companies perpetually operating at a loss.

Subsidies for rural electrification are not inherently objectionable, particularly if their goals are accomplished. Electrifying remote hamlets may be a political goal and a social imperative but assumes that the inhabitants will base their consumption decisions based on the price of electricity. This is only part of the calculus, as consumers will also

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135 UNEP, *Reforming Energy Subsidies,* 27.

136 Bhattacharyya, "Energy Access Problem," 3390.

137 Ibid.

138 Bhamy V. Shenoy, *Lessons Learned from Attempts to Reform India's Kerosene Subsidy,* International Institute for Sustainable Development, March 2010, 5. https://www.iisd.org/pdf/2010/lessons_india_kerosene_subsidy.pdf.

base their energy decisions on the reliability of the electrical supply. If the supply is unreliable, then consumers will rely on their traditional sources regardless of the amount of subsidies they receive. Further, rate subsidies are unlikely to greatly impact poor families without commensurate subsidies for electrical appliances. RGGVY went a long way toward electrifying the hinterlands but the subsidies and unmetered connections to politically powerful agricultural interests are not sustainable because they incur severe costs to the power companies. Operating on the verge of insolvency, utilities have no incentive to shoulder additional risk by extending services, particularly to those who do not share political connections. As a result of the poor reviews, RGGVY was reformed into the Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) program.

4. Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY)

Unsatisfied with the progress of the RGGVY and frustrated with political chicanery in power distribution, Indian Prime Minister Narenda Modi enacted the *Deendayal Upadhyaya Gram Jyoti Yojana*, or DDUGJY, "Scheme of GoI for Rural Areas."[139] As Figure 3 shows, the progress in Uttar Pradesh is substantial. Out of 97,813 villages in the state, only 224 remain unserviced, with all but 71 in progress; 21 of those have been awarded contracts to be electrified by the end of 2017 and the remaining 50 villages are uninhabited.[140] On the national scale, out of 597,464 villages, as determined by the 2005 Census, 590,967 have been electrified accounting for 98.9% of the total.[141] The DDUGJY has allocated approximately 9.5B Rupees (Rs) for the remaining projects in Uttar Pradesh alone out of Rs 756 billion earmarked for the total scheme.[142]

The money is split between electrification methods for the remaining villages; 8060 have been identified for grid expansion with 3433 to be electrified through off-grid

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139 "Deendayal Upadhyaya Gram Jyoti Yojana," Ministry of Power (MoP), accessed 26 July 2016, http://www.ddugjy.gov.in.

140 Government of India, *Status of Rural Electrification in Uttar Pradesh,* accessed 12 September 2016. http://164.100.154.160/mis/portal/state_wise_summary1.jsp?stateCode=09.

141 MoP, "Deendayal Upadhyaya Gram Jyoti Yojana."

142 Ibid.

means.[143] Politicians were presented with a number of courses of action, from expanding the grid via transmission lines and additional power plants to small microgenerators for remote village use. Preferring large projects, federal and state governments quickly become embroiled in boondoggles with frequent political turnover. This resulted in not only private investment withdrawal, but also established India as an unreliable investment partner. The local communities, on the other hand, enjoy a much better relationship as personal contacts and insider information are key. Foreign companies have found it far easier to conduct business in India through partnerships with local organizations but it still does not overcome the bureaucratic inertia nor the perception that it is difficult to do business in the country. After years of reforms and schemes, the electricity sector is largely unchanged; private investment is discouraged in favor of monopolistic state-owned enterprises.

Some GoI politicians have made strides in increasing transparency regarding efforts to electrify remote villages. Minister of State Piyush Goyal has been quite vocal in his advocacy, even going so far as to publish a mobile app for Android, Apple, and Windows devices that displays the number of electrified villages ahead of deadlines set by the DDUGJY.[144] On the rollout for the app, Minister Goyal tweeted, "Track in real time as we electrify every single one of our villages. Hold us accountable!"[145] The dashboard of the app, as shown in Figure 3, shows the total number of unelectrified villages and the status of those in progress. The Milestones tab, shown in Figure 4, shows the percentage accomplished measured against the days left in the program, expiring on March 31, 2017.

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[143] MoP, "DDUGJY Guidelines," accessed 30 July 2016, *www.**ddugjy**.gov.in/mis/portal/meeting_events_pdf.jsp?NEWS_NO=10061.*

[144] https://play.google.com/store/apps/details?id=com.phonegap.kyrovidyut.

[145] Piyush Goyal Twitter feed, November 16, 2015, https://twitter.com/PiyushGoyal/status/666266468791812098.

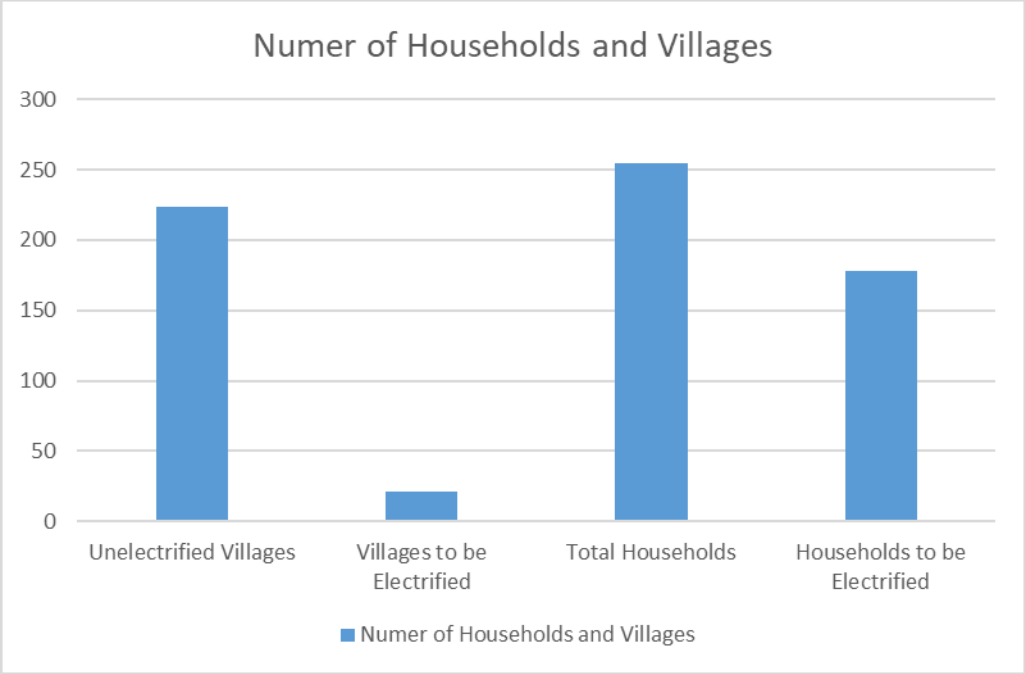

Figure 3. GARV Dashboard, December 13, 2016[146]

[146] GARV App screen capture via author's Android device.

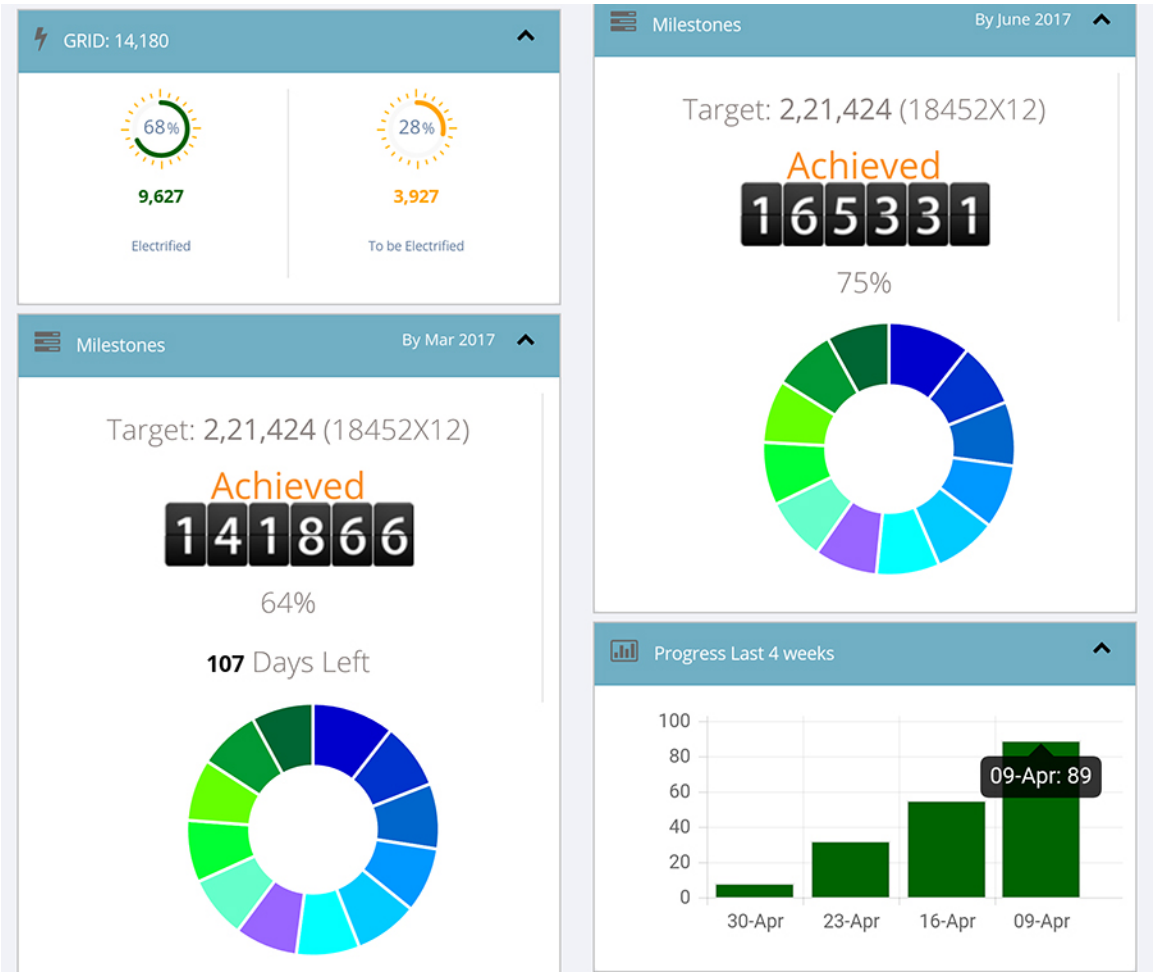

Figure 4. GARV Dashboard, December 13, 2016 (left) and April 24, 2017 (right).[147]

One of the leading criticisms of the DDUGJY program is, as in earlier programs, is the use of inappropriate metrics, e.g., the number of electrified villages vice households. This lack of "last-mile" support is the source of much frustration towards Delhi and state governments, but a great deal of frustration is also expressed toward the petty corruption experienced at the local level, where bribery runs rampant. While electrification at the customer level is challenging, overcoming established bureaucratic interests is even more so. Expanding grid supply to those regions that can support it presents even more political pressure to load centers. As discussed earlier, engineers are put under great pressure to

147 GARV App screen captures via author's Android device.

deliver promises made by politicians regardless of the risk of blackouts. While the political culture is changing with the promotion of electrification, it remains to be seen how readily entrenched interests will follow Delhi's lead.

5. Conclusion

This chapter explored the ways in which pre- and post-independence political economies and rent-seeking have affected the Indian government's electrification schemes and approaches to electricity subsidies. GoI's colonial and socialist experience has influenced the institutions that govern infrastructure development; early aversion to private enterprise has led to a social, political, and economic structure that is, at its most basic level, protective of bureaucratic and political careers. This careerism has developed into a patronage system that delivers public goods as a reward for those with political connections. Expansion of rural electrification is certainly impeded by engineering concerns and geography, but the impact of a small number of politically connected bureaucrats places huge pressure on service providers to deliver to favored constituencies vice the larger public.

Delhi has accepted the conventional wisdom that electrification has the potential to reduce poverty in both the short and long-term analyses. Despite the benefits that come with it, the household electrification rates still pale when compared with those of overall village electrification.[148] India's rural electrification experience follows the same triad of politics, technology, and finance that drove South Africa's programs. As discussed in the previous chapter, South African electrification schemes relied on subsidies and a distributed network of non-grid systems. Unfortunately, due to widespread theft and vandalism, the programs would not be sustainable without the continued subsidies. This is not to say the programs are without merit; as previously pointed out, healthcare outcomes and economic growth increase with electrification.

The expansion of the regulatory space is one of the means by which elites capture public goods for allocation to their clients. Until the opening of private providers in 2003,

[148] Khandeker, S.R., Samad, H.A., Ali, R., and Barnes, D.F., "Who benefits most from rural electrification? Evidence in India," *The Energy Journal,* 35(2), 2014. Doi: 10.5547/01956574.35.2.4.

the SEBs were the only source of electrical power and under the sway of elected officials and their client bureaucrats. Anecdotal evidence suggests that personnel changes were rampant depending on election results, thus ensuring uninterrupted service to the politician's favored constituencies.[149]

Privatization of providers has increased in the years since 2003 in part due to the rampant corruption but also due to the mismatched pricing structures that have led to insolvency of the SEBs. If SEBs cannot provide reliable power to their customers, then private individuals and organizations will fill the gap, creating so-called captive power plants. The Electricity Act's open access clause forced SEBs to permit private power transmission, creating a market whereby providers and distributors must compete for customers. This new operating space has the potential to reduce the effect of patronage relationships but the effects remain small due to the outsized production of the existing state and central utilities.

[149] Tapas Chakraborty, "Air and star power for CM village," *The Telegraph,* 5 September 2004, https://www.telegraphindia.com/india/air-and-star-power-for-cm-village/cid/714573

IV. CONCLUSIONS AND IMPLICATIONS

A. BARRIERS TO ELECTRIFICATION

Electrical demand, services, and implementation serves as an indicator of development, growth, and an increase in quality-of-life and is a key variable when considering India, roughly three-quarters of whose population live outside urban centers and a country home to a quarter of the world's poor. Conventional wisdom—as noted in multiple sources—holds that electrification has a direct impact to healthcare outcomes and a primary component of improved education. Access to electrical power that is affordable, reliable, and nonpolitical—particularly to the poor—has been acknowledged as a high government priority in terms of development and social progress, but efforts to electrify the hinterlands has been plagued by both technical and institutional barriers.

As discussed in chapter two, technical barriers, such as load factor and power distribution, are engineering problems. Such issues are exacerbated by the pursuit of solutions favored by politicians and elites that may not be the best remedy. The ongoing debate of grid vs non-grid—including microgenerator—systems revolve around technology, terrain, and organizational risk. Technological advances in both traditional and renewable generators are attractive but are unproven, particularly in impassible terrain and unpredictable conditions. India's experience with FDI and other private firms is lackluster and has created a culture of risk aversion; companies have failed to deliver on high-profile projects, leading to difficulty in financing new projects. While fulfillment of social obligations is a noble and worthwhile endeavor, fiscal viability is a non-trivial concern. Bureaucracies are often focused on benchmarks and metrics for a number of reasons, many of them valid. However, such metrics should be redefined from simple installation and moved toward evaluating the economic and health outcomes in specific areas or villages. Focusing on outcomes would force the consideration of decentralized factors such as electrical consumption and the availability therein, including a stable and reliable supply

Customer behavior also impacts the available solutions. If customers do not, or cannot, acquire consumer appliances or engage in commerce, the demand, i.e., load, may

be insufficient to continue operations. Underloading generators has deleterious effects and can force the operator to shut down operations. Naturally, the reliability problem creates a cycle; power availability is reduced because not enough people have electrical devices, but they are unwilling to purchase them because the power is not reliable. This can be partially addressed by information and marketing campaigns order to combat this, encouraging customers to invest in electrical appliances perhaps by highlighting the social benefits that come with stable electricity (e.g., advanced medical care).

Engagement at the local level as well is an essential part of administering an electrical system. Bill collection and maintenance are best performed at a local level to minimize default, theft, and vandalism. Providing a sense of ownership to the locality ensures that abuse and theft is minimized, while reliable bill collection ensures continuous viability of the electrical project. Training local residents to operate and maintain their systems has been proven to reduce reliance on external experts. Local experts are best suited for developing their own short- and long-term planning needs, including fuel supply and maintenance requirements.

The regulatory space in which electrical infrastructure operates has traditionally used a combination of subsidies and taxes along with regulations in order to further electrification goals as seen in chapter three. The results have been nearly opposite, though, as heavy subsides effectively price-out non-state actors, who are left to struggle for largely unavailable financing. GoI's centralized strategy for implementation and expansion discourage contributions from NGOs and the private sector. Commercial credit is nearly nonexistent or requires untenable conditions for repayment due to a lack of project successes that would build investor confidence. Policies such as the Electricity Act of 2003 have done little to ameliorate the regulatory hurdles to generation and distribution. Current legislation allows for rent-seeking behavior and bureaucratic delays, further discouraging private innovation and involvement.

India's energy policies and practices have steadily shifted from the socialism favored in the Nehru and Gandhi years. The development of alternative political parties and the organization of agricultural elites eventually directed the sector away from state-ownership toward private generation. Despite the progress made by the electrification

schemes since 2003, Delhi's approach remains centralized, curiously at odds with the distributed non-grid solutions presented for rural villages. This centralization tends to discourage local organizations and NGOs due to the institutional barriers to entry. Without the central planners' imprimatur, commercial credit and funding is nearly non-existent, but the market for market for renewable solutions is flourishing.

B. KEY FINDINGS

India's political legacy of integrating socialism, nationalism, and democracy has resulted in an unstable foundation for improving the electricity sector. Foreign direct investment was implemented in 1991 as a result of a monetary crisis rather than any legitimate political initiative. Additionally, GoI favored grand, large-scale schemes rather than engage in smaller, more controlled projects, thus reducing the opportunity for lessons learned. GoI also created transparency problems by fast-tracking projects while refusing compromise on end-states regardless of how realistic the expectations were. These conditions led to frequent course changes with respect to Indian policy while maximizing profits for foreign investors as capital was received but no expenditures could be made.

Geography is a determinant in terms of investment and, ultimately, public goods and services. India's colonial experience showed that such investment was only made where it was likely to maximize returns on said investment and further trade expansion. Thus, people who chose to not live in urban centers were largely abandoned by modernity; there was no choice to have the best of both worlds. This has the potential of initiating a death spiral wherein rural elites depart for the urban cities, leaving the poorest in the areas with neither access to public goods nor the avenues the gain it. While seventy years have passed since independence, the impact of colonization is still felt as the attitudes of those in the *zamindari* and *raiyatwari* areas have been institutionally entrenched. Attempts at reform will need to address the root causes of these perceptions and a cultural shift in political relationships.

Conventional means of meeting rural electrification goals will not be as efficient or successful if institutional barriers to entry are not lifted. Sector reforms to date have attempted to shift authority away from the vertical state-owned enterprises and promote

private enterprise and foreign investment. This is not simply a sector realignment or a promotion to attract capital; the socialism of Nehru and Gandhi viewed electricity as a statement of the benefactor-beneficiary relationship between government and the governed. Shifting to a private enterprise model refutes this relationship. Scholars have noted the inefficient and insolvent electricity sector and while the cited causal factors range from purely engineering or other technical problems to bureaucratic issues such as rent-seeking. Regardless, the factors point toward a broader institutional failure to provide electricity, particularly to the most poverty-stricken citizens, but financial pressures cannot be discounted as a causal factor for sector reform as seen in the early 1990s and 2003. Distributed generation schemes such as SHS and small local generators are well-suited to providing power to populations that cannot realistically be served by the existing grid. Such schemes also have a high probability of bill payment; by ensuring payment and discouraging theft, local projects have a higher likelihood of securing financing. Affordability is key to encouraging households to choose electricity over more primitive and unhealthy energy production.

Income, the other side of the affordability coin, also plays a significant role in a family's decision regarding energy sources. Perhaps unsurprisingly, higher-income households generally choose "more efficient and more convenient sources of energy such as gas and electricity, while poor people use less efficient and less convenient sources such as fuelwood and human energy."[150] Delhi has pushed for rural electrification but they have struggled with numerous schemes. Even with access to basic service, many households cannot afford it and continue to burn solid matter; the only cost is the time it takes to collect the fuel. While this has non-trivial opportunity costs, it still largely explains why roughly 69% of the population rely on wood and dung for fuel.[151] Banerjee's declaration—that

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[150] Elisabeth Cecelski, *Enabling Equitable Access to Rural Electrification: Current Thinking and Major Activities in Energy, Poverty, and Gender*, (Washington D.C.: World Bank, April 2000), 8. http://documents.worldbank.org/curated/en/850681468328564938/pdf/345310Equitable0electrification0access.pdf

[151] Gwanaelle Legros, Ines Havet, Nigel Bruce, and Sophie Bonjour, *The Energy Access Situation in Developing Countries: A Review Focusing on the Least Developed Countries and Sub-Saharan Africa*, (Washington, D.C.: World Health Organization, November 2009), 19, http://www.undp.org/content/dam/undp/library/Environment%20and%20Energy/Sustainable%20Energy/energy-access-situation-in-developing-countries.pdf

access to public goods is determined by the ability to extract them from the political system—still holds true.[152]

Rural electrification has numerous benefits, not the least of which includes better health and economic development. However, India's centralized control of power at the state level, combined with a history of customer default and market distortions caused by heavy regulation and subsidies, have hamstrung rural electrification efforts. Decentralization of non-urban power supply is key to ensuring efficient operation. Local partnerships are better suited to negotiate directly with vendors; small-scale engineering and financial challenges are better overcome without national bureaucratic interference and can be tailored to each community's needs. While centralized control of a grid may be necessary—and perhaps even beneficial—in urban centers, local control of a non-grid system will likely yield better results in rural or inaccessible locales. Providing power across the states is an inclusive goal that will only benefit all members of Indian society.

The political-technical dyad presented here represents the confluence of politics, patronage, and technology. Given the relationship between the three, it appears that electricity may not be the prime mover for economic growth but rather the catalyst for social and political change that growth requires. Technical and financial leaders should concentrate on developing reliable solutions that are priced appropriately and join forces with local leaders in order to build and set expectations for consumers. Likewise, regulators should be engaged to realign institutional capacity and develop regulations that foster a consumer-friendly environment instead of one that enriches elite patrons.

As an aspect of human nature, technical innovations are more attractive than new political schemes and regulations. In other words, promoting the latest technology without concurrent modification to the regulatory space will have no appreciable benefits. Similarly, market dynamics in and of themselves will fail to achieve the desired outcomes. If Delhi truly desires to shift to a broader market environment, the regulatory space needs a vision and roadmap to outline the transition that minimizes institutional disruption, encourages market development, and delivers affordable and reliable power. The greater

[152] Banerjee, "Who is getting the public goods in India."

effects in improving rural electrification lie in overcoming the barriers in government, bureaucratic, and social institutions. Institutions are not merely political entities, but rather avatars of political, social, and cultural norms. Attempts at energy reform need to address each of those in order to overcome bureaucratic inertia. Solutions to electrification must be at least as comprehensive as the environment in which they operate and a holistic vision is required in order to secure a healthy power sector.

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